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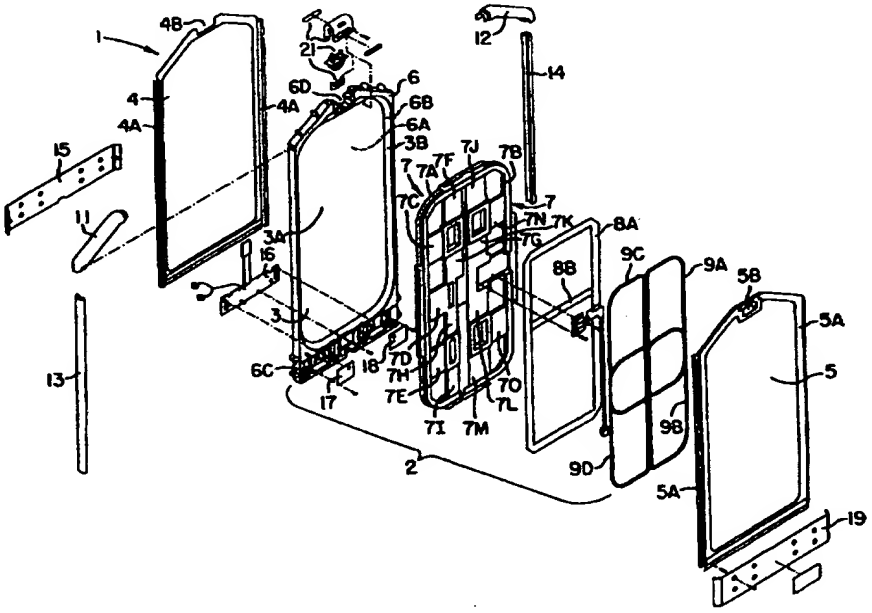


(57) Abstract

An antenna shield (3) comprised of a single continuous sheet of material formed into a concave shape having a central section (3A) and a lip section (3B) extending arcuately and then transversely of the central section (3A). The antenna shield (3) is nested with a concave shaped molded plastic shield support (6) and a molded plastic antenna support (7) nests with the shield (3) and shield support (6) and has a surface (7B) with details (7C-7O) for positioning transmitter and receiver antennas (8A, 8B, 8C, 8D and 9A, 9B, 9C, 9D).

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# IMPROVED ANTENNA SHIELD AND ANTENNA ASSEMBLY

## Background of the Invention

This invention relates to an electronic article surveillance ("EAS") system and, in particular, to an antenna shield and an antenna assembly for use in such a system.

In a conventional EAS system, transmitter antennas are used to transmit electromagnetic fields into an interrogation zone. When an EAS tag is present in the zone, the tag causes a perturbation in the transmitted field which can be sensed by the receiver antennas of the system. The sensed EAS tag signals are coupled by the receiver antennas to a central processing unit which detects the signals and causes an alarm signal to be generated.

In an EAS system of this type, it is important that the field transmitted by the transmitter antennas be confined to the interrogation zone. It is also important that the receiver antennas be isolated from electrical noise and from any EAS tag signals and other unwanted signals generated outside the interrogation zone.

In order to accomplish the above, various forms of antenna shields have been used for shielding the transmitter and receiver antennas. One form of shield comprises a laminate of flat sheets of pre-selected magnetic and conductive materials which is situated adjacent the transmitter and receiver antennas. Another form of shield also comprises a laminate of sheets of material, but with the ends of the sheets bent or angled forward to provide enhanced retention of the field within the interrogation zone. In this form of shield, conductive strips are also placed adjacent the bends to prevent field leakage through the bend areas. A description of this type of shield can be found in U.S. Patent Number 5,130,697.

While the above shields have proved successful in providing the desired shielding effects, they require a laminate of multiple sheets of material. Additionally, where sheets are used with bends, additional conductive strips must also be employed.

The need for multiple sheets of material and conductive strips increases the thickness of the shield and, hence, the overall thickness of the antenna assembly incorporating the shield. This prevents use of the shields in applications where narrow or thin antenna assemblies are desired, such as, for example, in check-out aisles of stores.

Additionally, the use of multiple sheets of material and conductive strips increases the cost of fabricating the antenna assemblies, which is also undesirable. Finally, these prior shields have been designed primarily for low frequency applications and perform less favorably in higher frequency magneto-mechanical EAS systems of the type described in U.S. patents 4,510,489 and 4,510,490, which typically might operate at 58-60 KHz.

As above mentioned, the above shields are incorporated with their respective transmitter and receiver antennas into antenna assemblies. This has been accomplished using brackets and clamps to hold the antennas and shields together. Fabrication of the antenna assemblies in this way requires careful alignment and spacing procedures, which if not carried out accurately, can result in reduced system performance causing increased susceptibility to electrical noise.

It is, therefore, an object of the present invention to provide an antenna shield which is of simple configuration.

It is a further object of the present invention to provide an antenna shield which is of thin construction, and easily arranged in an antenna assembly.

It is also an object of the present invention to provide an antenna shield which can be satisfactorily used at higher frequencies.

It is yet a further object of the present invention to provide an antenna assembly which facilitates arrangement of the antennas and antenna shield into the assembly.

It is also an object of the present invention to provide an antenna assembly which is strong, light weight, easy to fabricate and resistant to environmental abuse.

Summary of the Invention

In accordance with the principles of the present invention, the above and other objectives are realized, in part, in an antenna shield comprising a continuous sheet of metallic material having a central section and a lip section extending from and about the periphery of the central section. The lip section extends arcuately from the periphery of the central section and then in a direction transverse thereto so that the shield takes the form of a concave member or shallow bowl.

In the embodiment of the invention to be disclosed hereinafter, the metallic material is pre-annealed cold rolled steel and the central section is of rectangular configuration. The shield is formed from a flat sheet of material which is cold worked to form the central section and lip section. Cold working of the sheet material is kept at a level which both maintains the magnetic shielding properties of the material and achieves relative smoothness of the material without significant kinks, folds or wrinkles in the corner areas of the lip section.

In a further aspect of the present invention, an antenna assembly is provided in which a molded shield support supports the antenna shield in nested relationship. A molded antenna support nests with the nested shield support and shield. A surface of the molded antenna support includes details for positioning the transmitter and receiver antennas in preselected relationship with each other and the antenna shield.

In the embodiment of the invention to be disclosed hereinafter, the surface details in the molded antenna support are in the form of recessed areas.

Description of the Invention

The above and other features and aspects of the present invention will become more apparent upon reading the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 shows an antenna pedestal including an antenna assembly and antenna shield in accordance with the principles of the present invention;

FIG 2. shows an exploded view of the antenna shield support and antenna shield of the antenna assembly of FIG. 1;

FIG. 3 shows the antenna support surface of the antenna support of the antenna assembly of FIG. 1; and

FIG. 4 shows an assembly for forming the antenna shield of FIG. 2.

Detailed Description

FIG. 1 illustrates an exploded view of an antenna pedestal 1 incorporating an antenna assembly 2 having an antenna shield 3 in accordance with the principles of the present invention. The antenna pedestal 1 includes front and back plates 4 and 5 having vertical edges 4A and 5A, respectively, which are formed as mating hooks. The plates 4 and 5 enclose the antenna assembly 2 and give an aesthetically pleasing finished look to the pedestal structure.

The antenna assembly 2 itself includes a shield support 6, the shield 3, an antenna support 7, transmitter antennas 8A and 8B and receiver antennas 9A - 9D. As can best be seen in FIG. 2. the shield support 6 is in the form of a molded plastic shallow bowl or concave member having a rectangular central region 6A and a flange or lip portion 6B which extends arcuately and then transversely from the central region.

The shield 3 is of thin, flexible, metallic construction and is nested within and adhesively bonded to the shield support 6. The shield 3 has a central region 3A and a lip region 3B extending arcuately from the periphery of the central region and then transversely thereto to give the shield also a shallow bowl or concave shape. The presence of the lip region 3B on the shield 3 helps to enhance the shielding effect of the shield by providing points of attraction for magnetic flux lines.

The shield 3 is formed from a sheet of standard pre-annealed metallic stock. Typically, the sheet material

might be cold rolled steel having a thickness of .006 inches and which has been pre-annealed to maintain the desired magnetic shielding properties. As will be explained more fully below, in forming the sheet material into the desired bowl or concave shape, the degree of cold working of the sheet is kept to a level which avoids substantial degradation in the magnetic shielding properties of the material, while realizing relative smoothness without significant kinking, folding or wrinkling, particularly in the corner areas of the resultant concave member. This facilitates nesting of the shield and avoids areas of bulging in the antenna assembly and completed pedestal.

The molded antenna support 7 has opposing first and second surfaces 7A and 7B and nests with the nested assembly of the shield 3 and shield support 6. The surface 7B of the antenna support 7 includes molded in details for positioning the receiver antennas 9A - 9D and transmitter antennas 8A - 8B. These details are in the form of recessed areas 7C - 7O. Additionally, they can be in the form of positioning ribs.

The antennas 9A - 9D and 8A - 8B are positioned via the above mentioned details against the surface 7B of the antenna support and are secured thereto by an adhesive such as an epoxy cement. With the antennas secured to the support 7 and the latter support nested with the shield 3 and the shield support 6, upper shoulders 11 and 12 and side pieces 13 and 14 capture the antenna support 7 and the shield support 6 and hold them together to form the resultant antenna assembly 2.

As can be seen in FIGS. 1 and 2, the lower part of the shield support 6 is provided with a bay area 6C for housing electronics for the pedestal. This bay area is closed off by plates 15-19 which are suitably secured thereto and by the front and back plates 4 and 5. Similarly, the upper part of the shield support includes an indentation 6D for receiving a lamp assembly 21 which can be seen through a viewing glass 5B in the upper part of the front plate 5. An indentation 4B in the upper part of the back plate 4 allows access to the lamp assembly 16.

With the antenna assembly 2 formed as above described, the assembly exhibits the characteristics of a relatively thin, strong, rigid, flat structure. This is a result of the use of the relatively flat, single sheet shield 3 and the nesting of the shield with the shield support 6 and the antenna support 7. The overall antenna pedestal 1 comprised of the antenna assembly 2 and back and front plates 4 and 5 exhibits similar characteristics, i.e., is thin, strong, rigid and flat. This, in turn, makes the pedestal especially attractive for use in aisle locations in stores where a minimum of disturbance to the aisle traffic is desired.

As previously discussed, the shield 3 is formed from a sheet material having the desired magnetic shielding properties and which is formed into the desired shallow bowl or concave shape from a standard stock of pre-annealed cold-rolled sheet material. This is accomplished as shown in FIG. 4, by cold-working the sheet material by using a press 31 to force the material into a die 32 with the desired bowl or concave shape. In order to maintain the given magnetic shielding properties of the sheet material, and realize the desired marginal degree of kinking, wrinkling or folding in the resultant shield, particularly in the corners, tension members 33 are placed about the periphery of the sheet as it is being pressed. These members control the stretching of the material, so that the residual stress remaining in the material after the forming process does not degrade the magnetic properties of the material and so that any kinking, wrinkling or folding is not excessive.

A typical sheet material for forming the shield 3 might be a .006 inch thick sheet of pre-annealed cold rolled steel. Also, the tension members 33 are normally set so there is no more than a few (less than about 4) kinks, wrinkles or folds in the corner areas of the resultant concave member. Typical dimensions for the shield 3 might be a length and width for the central region of 4 feet and 2 feet. A typical lip section may comprise a 90° arc of radius 1.5 inches.

In all cases it is understood that the above-described arrangements are merely illustrative of the many possible specific embodiments which represent applications of the present invention. Numerous and varied other arrangements, can be readily devised in accordance with the principles of the present invention without departing from the spirit and scope of the invention. Thus, for example the shield 3 can have a central region which is other than rectangular such as, for example, circular. Also, the sheet material used to form the shield 3 need not be pre-annealed.

What is Claimed

1. Apparatus for use in an electronic article surveillance system comprising:

an antenna shield including a continuous sheet of metallic material having a central section and a lip section extending from and about the periphery of the central section, said lip section extending arcuately from said periphery of said central section and then extending in a direction which is transverse to said central section.

2. Apparatus in accordance with claim 1 wherein:

said shield is concave shaped.

3. Apparatus in accordance with claim 2 wherein:

said metallic material is steel.

4. Apparatus in accordance with claim 3 wherein:

said steel is cold rolled and pre-annealed.

5. Apparatus in accordance with claim 4 wherein:

the thickness of said sheet is in a range of .006 inches.

6. Apparatus in accordance with claim 2 wherein:

said central section is rectangular in shape.

7. Apparatus in accordance with claim 6 wherein:

said lip section in the peripheral corner areas of said central section has limited wrinkling.

8. Apparatus in accordance with claim 1 further comprising:

a molded shield support for supporting said shield in nesting relationship.

9. Apparatus in accordance with claim 8 wherein:

said molded shield support has a central region and a lip region extending arcuately from the periphery of said central region and then transversely thereto.

10. Apparatus in accordance with claim 9 wherein:

said molded shield support is concave shaped.

11. Apparatus in accordance with claim 10 further comprising:

a molded antenna support nesting with said shield and said molded shield support, said molded antenna support having a first surface resting against said shield and a second surface having molded-in details for supporting antennas in pre-selected relationship with each other and said shields.

12. Apparatus in accordance with claim 11 wherein:

said molded-in details include recessed areas in said second surface.

13. Apparatus in accordance with claim 12 wherein:

said recessed areas are vertically and horizontally spaced.

14. Apparatus in accordance with claim 12 further comprising:

transmitter and receiver antennas positioned by said recessed areas.

15. Apparatus in accordance with claim 14 further comprising:

front and back plates affixed to said nested structure of molded shield support, shield and molded antenna support.

16. Apparatus in accordance with claim 15 wherein:

said molded shield support and said molded antenna support are each formed of a molded plastic material.

17. Apparatus in accordance with claim 11 wherein:

said molded shield support and said molded antenna support are each formed of a molded plastic material.

18. A method of making an antenna shield comprising the steps of:

providing a sheet material; applying a force against a central section of said sheet material so as to cause a lip section to form about the periphery of said central section, said lip section extending arcuately from said periphery of said central section and then extending transverse to said central section;

and holding the edges of said sheet material with pre-selective forces while applying said pressure to said central section, whereby the magnetic shielding properties of said sheet material are kept at a preselected level and the wrinkling of the sheet material is kept at a preselected level.

19. A method in accordance with claim 17 wherein:

said sheet material is pre-annealed, cold rolled steel.

20. A method in accordance with claim 19 wherein:

the thickness of said sheet material is .006 inches.

21. A method in accordance with claim 18 wherein:

said applying of force includes cold working of said sheet material.

22. Apparatus for use in an electronic article surveillance system comprising:

an antenna shield;

a molded shield support for supporting said shield in nesting relationship;

a molded antenna support nesting with said molded shield support, said molded antenna support having a first surface resting against said shield and a second surface having molded-in details for supporting antennas in pre-selected relationship with each other and said shields.

23. Apparatus in accordance with claim 22 wherein:

said molded-in details include recessed areas in said second surface.

24. Apparatus in accordance with claim 22 wherein:

said molded shield support and said molded antenna support are each formed of a molded plastic material.

25. Apparatus in accordance with claim 22 further comprising:

transmitter and receiver antennas positioned by said recessed areas.

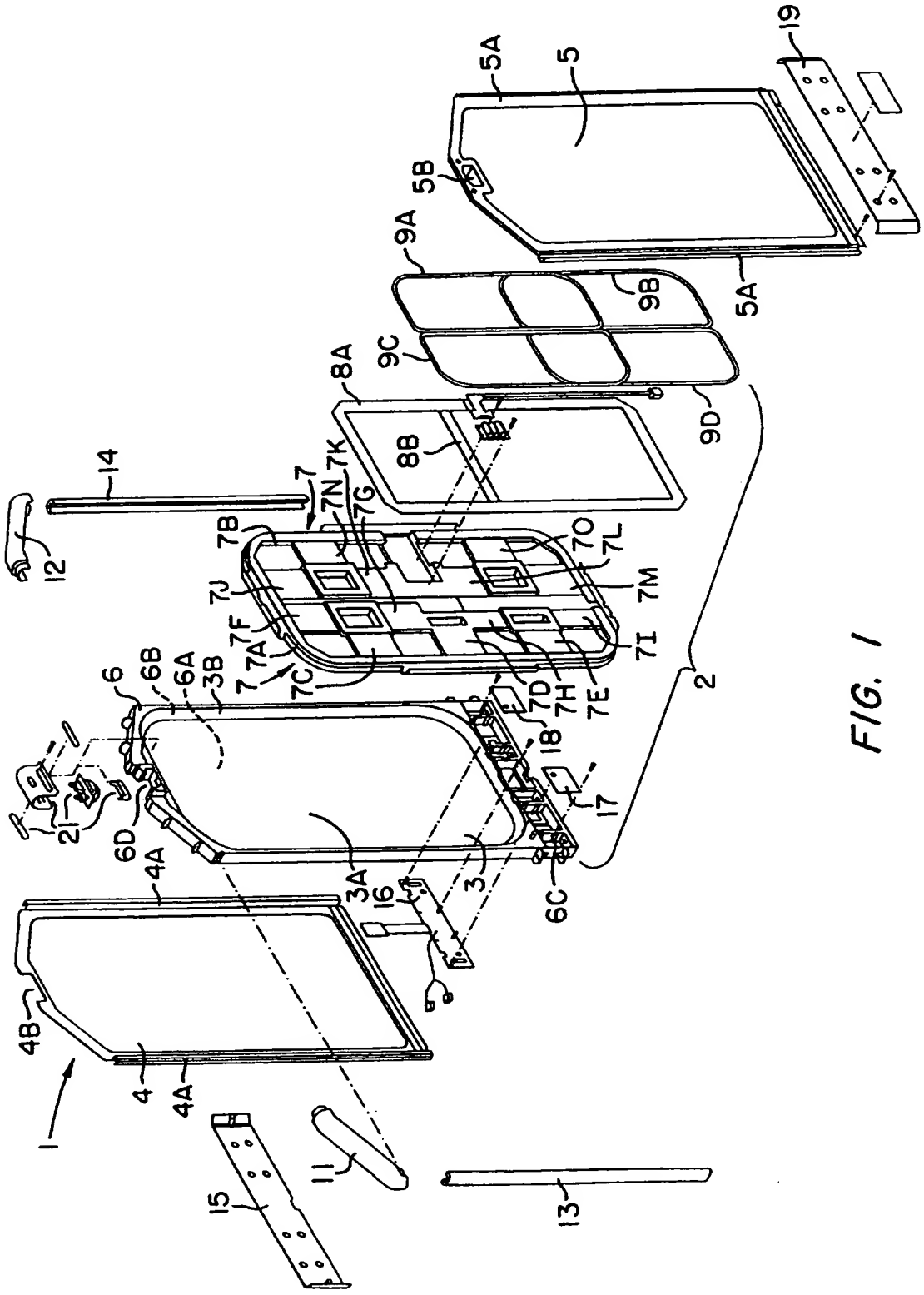
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FIG. 1

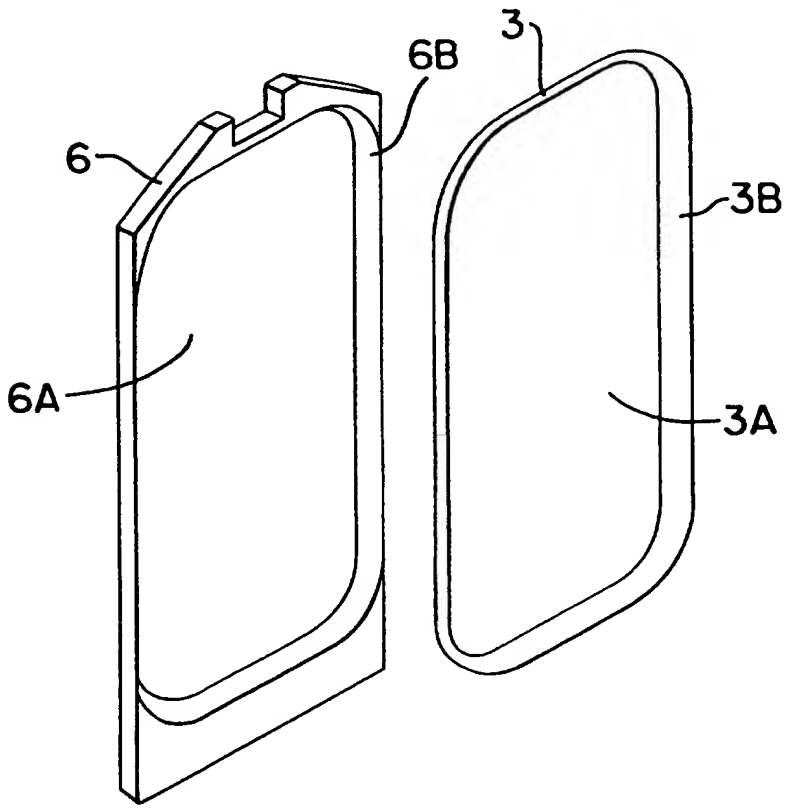


FIG. 2

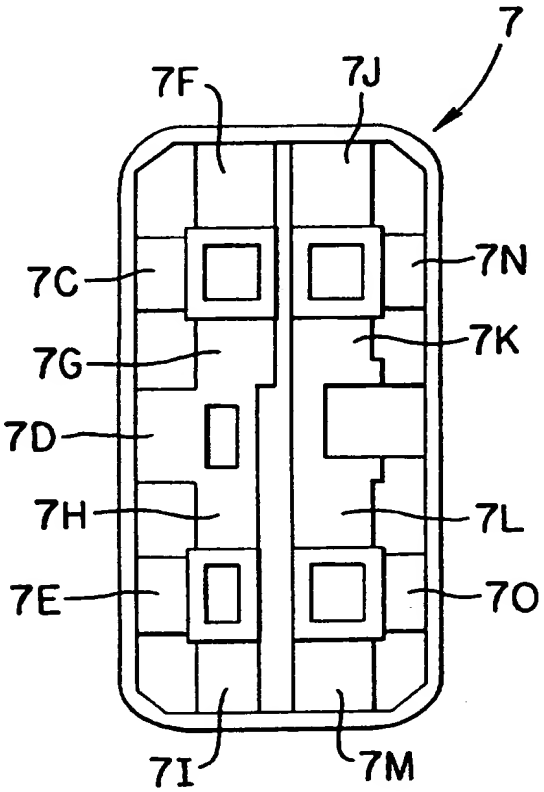


FIG. 3

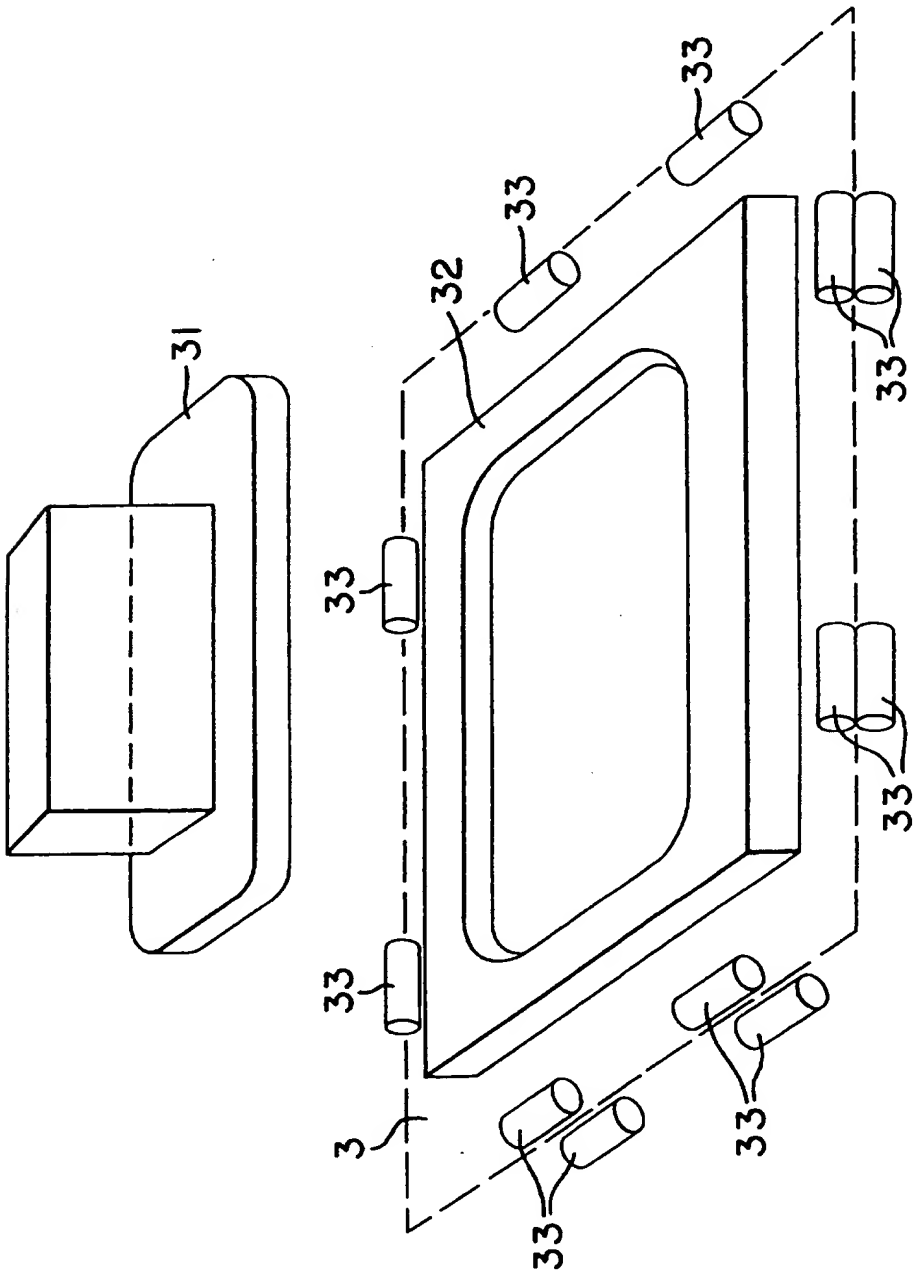


FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/17220

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :H01Q 1/36, 1/52
US CL :343/841
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 343/702, 742, 841, 842, 867

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br>–<br>Y | US 5,130,697 A (McGinn) 14 July 1992, col. 8, line 37 to col. 1,2 line 3 and Figures 8-10. | 1-4,6,7,18<br>———<br>5,19,20,21 |
| Y | US 5,345,222 A (Davies et al.) 06 September 1994, col. 2, lines 20-26. | 5,19,20,21 |
| Y | US 4,859,991 A (Watkins et al.) 22 August 1989, col. 19, line 55 to col. 20, line 19 and Figures 13 and 14. | 8-17,22-25 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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